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Original Research Article

Outbreaks of measles in Rajasthan in 2014: a cross sectional epidemiological investigation

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ABSTRACT

Background: In India, although the measles vaccine is available across the country up to village level, but still India is struggling with mortality and morbidity associated with Measles and its outbreaks. Investigations in measles outbreak help to know the determinants behind it and thus prevent further outbreaks. The outbreaks of measles in Rajasthan were investigated in 2014 by analyzing various socio-demographic parameters. Objective: To assess the epidemiological profile of measles outbreak in Rajasthan in 2014.
Methods: The data of the measles surveillance project of Rajasthan was used for analysis. This is an analytical, cross sectional study where 10 districts of Rajasthan having confirmed measles outbreak in 2014 were included. A total of 353 laboratory plus epidemiologically linked measles cases were considered. Statistical analysis: Percentages, proportions and Chi square test were applied.
Results: Out of the 23 suspected measles outbreaks subjected for confirmatory laboratory investigation, majority i.e. 14 (60.8%) were found to be of measles. Out of these 14 outbreaks, 353 cases were of measles (Laboratory confirmed + epidemiologically confirmed). Maximum numbers (around 50%) of cases were from the age group 1-4 years. Only 108 (30.6%) cases were vaccinated for measles vaccine. Girl children contributed to about 60 % of the total measles cases. Almost 2/3rd (66.9%) cases were in Muslim families.
Conclusions: There was clustering of measles cases in few of the districts adjacent to each other. Measles vaccination coverage in few pockets was poor in outbreak districts. There is a need to boost up measles vaccination coverage with special attention to high risks areas like urban slums etc.

Keywords: Measles outbreak, Measles epidemic, Measles in India, Epidemiologically confirmed measles, Surveillance, Measles IgM, Rubella IgM, Immunization

INTRODUCTION

Measles is a highly contagious, serious viral disease caused by paramyxo virus of genus Morbillivirus.[1] There are references to measles as far back as the 7th century A.D.[2] The 10th Century Persian physician, Rhazes; considered measles "to be dreaded more than smallpox." [3] Measles spread mainly via coughing and sneezing and characterized by fever and maculo-papular rash.[2] The disease spreads so fast that on average, about 90% of those unvaccinated persons exposed to someone with measles will get the disease.[4] The Case Definition of Measles includes any person in whom a clinician suspects measles infection, or any person having fever with maculopapular rash and one of the three "Cs" - cough, coryza and conjunctivitis. A case of measles is designated

as epidemiologically confirmed measles case that meets the clinical case definition and is linked to a laboratory-confirmed case.[5]

In 1980, before widespread vaccination programs, measles was a cause of an estimated 2.6 million deaths each year globally. Wide spread immunization activities promoting measles vaccination had a major impact on reducing measles deaths. Global measles deaths have decreased by 79% from an estimated 6.5 Lakhs in year 2000 to 1.3 lakhs in the year 2015. During 2000-2015, measles vaccination prevented an estimated 20.3 million deaths. [6] With a high measles case-fatality rate (CFR) in the malnourished children, India accounts for a significant proportion of measles deaths in the world.[7] There were 1112 and 526 serologically confirmed measles outbreak in India in 2015 and 2016 respectively. There were 61255 cases of measles reported from India in 2015 and the respective figure from Rajasthan from the same period was 1769.[8]

Measles vaccination was introduced into India's Universal Immunization Program in 1985. Low routine coverage of measles vaccination and less effectiveness of measles vaccine (about 15% of vaccinated children fail to develop immunity from the first dose) created a large cohort of susceptible children during subsequent years.[6,9] So In November 2010, on the recommendations of national technical advisory group on immunization (NTAGI) , the Government of India (GOI) introduced a second dose of measles in a vaccination drive in 14 high-risk states, targeting 134 million children, to prevent an estimated 60,000 to 100,000 child deaths annually.[10,11] At present, every Indian state have been covered and two dose measles vaccine is being provided to children under national immunization Program.[12] The first dose is recommended at 9-12 months of age and second at 16 -24 months along with pentavalent vaccine.[13] However, if any child missed any of these doses, it could be given up to five years of age with an interval of at least 4 weeks between the two doses.[14]

Globally, an estimated 450 people, mostly children, die every day from measles. This is despite the availability of an effective and safe vaccine against measles at a very low cost. It costs less than $1 to vaccinate a child against measles. In 2015, about 85% of the world's children received at least one dose of measles vaccine by one year of age through routine health services – up from 73% in 2000. [6] In India, although the measles vaccine is available across the country up to village level and that too absolutely free of cost to the end user, India is still struggling with mortality and morbidity associated with Measles. The measles vaccination coverage in India was 78.8 % as per Rapid Survey on Children (RSON 2013-14) records of Government of India. [12] If we take into account the large population of India and convert this percentage into the absolute numbers, the country will be left with a very large cohort of children unvaccinated for measles.

Out of 638 districts in India, only 242 (38%) districts had 90% coverage for Measles first dose.[15] The poor coverage of measles immunization could be attributed to various barriers. These include socio demographic parameters (e.g. higher birth order, poverty, lower parental education, religious resistance to immunization, poor knowledge of vaccination etc.); remote and difficult-to-reach areas; inadequate infrastructure, human resource, and communication; issues of vaccine storage, transport, and cold chains; almost non-existing surveillance activities for reporting of adverse events following immunization and inadequate and late outbreak response.[16] Vaccination coverage varies considerably from state to state, with the lowest rates in India's large central states. Differences in uptake are geographical, regional, rural-urban, poor-rich and gender-related. On average, girls receive fewer immunizations than boys and higher birth order infants have lower vaccination coverage. Rural children are least likely to have complete vaccination, and this inequity is most pronounced in states like Madhya Pradesh, Rajasthan, Chhattisgarh, Jharkhand, and Uttar Pradesh. [17]

To push the measles vaccination drive, The Measles & Rubella Initiative (M&R Initiative) was Launched in 2001 which is a global partnership led by the American Red Cross, United Nations Foundation, Centers for Disease Control and Prevention (CDC), UNICEF and WHO. The M&R Initiative is committed to ensure that no child dies from measles or is born with congenital rubella syndrome; reducing measles deaths by 95% by 2015; and achieving measles and rubella elimination in at least 5 WHO regions by 2020.[6] Elimination of measles means absence of continuous measles transmission for greater than 12 months.[18] The World Health Organization (WHO) has declared Brazil free of measles in 2016, after no case of the disease was registered in the previous last year.[19]

But at present, when India is still struggling with measles outbreaks, investigations of the measles outbreak are important tools to further know about the disease dynamics, socio- cultural and geographical factors affecting disease spread and efficiency of health system responsible for vaccination coverage and prevention and control of disease. The present study was undertaken to understand the complex web of disease spread and outbreak investigations.

METHODS

Study area

This study was undertaken in the state of Rajasthan (India). All 33 districts of Rajasthan were under the

measles surveillance and only 10 districts having confirmed measles outbreak were included in the study.

Study design

Community based, analytical, cross sectional study. The data of the measles surveillance project of Rajasthan was used for analysis.

Study size and sample

A total of 353 laboratory plus epidemiologically linked measles cases were considered for the current study.

Study period

The study period was from 1st January 2014 to 30th June 2014.

Study tools and technique

An epidemiologically-linked measles case is a patient who meets the clinical case definition and has direct contact with another laboratory-confirmed measles case whose rash onset was within the preceding 21 days.[20] Under the measles surveillance, the trigger for preliminary outbreak investigation is either five or more clinical cases of measles in a block or different adjacent blocks in a week or any measles associated death in a block in a week.[2]

Based on reports of district health authorities (Collated data of acute flaccid paralysis cum measles weekly report and integrated disease surveillance report), outbreak was suspected as per definition mentioned above. District Immunization Officers flag the outbreak and instruct the local health functionary (Health Worker or Medical Officer) to do preliminary investigation to find out if there are more cases in the same area/village or adjoining areas/village. If sufficient number of additional cases are found, detailed house to house search was conducted by the team of health workers and cases having onset of rash or death in the last 3 months are line listed. Out of these listed cases, 5 cases having onset of rash between 4 – 28 days prior to date of line listing were selected for blood sampling to confirm outbreak. These samples are sent to World Health Organization (WHO) accredited laboratory at SMS Medical College, Jaipur where samples were tested for Measles IgM and Rubella IgM. The laboratory reports were used to classify outbreak.

Measles Outbreak (if 2 or more samples were positive for measles IgM), Rubella Outbreak (if 2 or more samples were positive for Rubella IgM and Mixed outbreak (If 2 or more samples were positive for both Measles and Rubella IgM).

Preventive and clinical outbreak management measures were taken at the time of detailed House to House Search/Investigation in the form of appropriate management of clinical cases, two doses of Vitamin A and vaccination of unvaccinated eligible child.

There was no of conflict of interest and no financial help from any source were involved in conduction of this study.

Statistical analysis

Collected data were entered in Microsoft Excel and were analyzed using software Statistical Package for Social Sciences (SPSS) version 16.0. Descriptive statistical measures such as percentage, mean were applied. Inferential statistical tests such as Z-test and Chi-square test were applied to identify important relationships between variables and determine the level of significance. A p-value of <0.05 was considered statistically significant.

Ethical clearance

The first author worked in the capacity of sub-regional team leader (WHO) of Rajasthan region during the study period and was involved in investigation of the measles outbreaks in 2014. The confidentiality has been maintained and the information thus obtained has not been used for any other purpose except for academic purposes. Hence no conflict on ethical issues and thus not required.

RESULTS

Out of the 24 outbreaks flagged during the study period in Rajasthan, preliminary inquiry and detailed House to House investigation was conducted and 23 outbreaks were subjected for further confirmatory laboratory investigation.

Table 1: Status of suspected measles outbreaks in Rajasthan.

	No. of outbreaks	No. of Cases
Flagged	24	-
Detailed House-to-House Investigation	23	-
Measles outbreaks	14	273
Rubella outbreaks	02	21
Mixed outbreaks	01	80
Negative for Measles and Rubella	06	

Majority of these outbreaks i.e. 14 (60.8%) were found to be measles and only 1 (4.3%) outbreak was mixed (Measles and Rubella). District health authorities' listed 353 cases in these 14 outbreaks as measles cases (Lab confirmed + epidemiologically confirmed) and all of these 353 cases were used for analysis in the present study (Table 1).

Only 09 districts of total 33 districts of state had confirmed measles outbreak while mixed outbreak was detected only in one district i.e. Jaipur. Rest of the 23 districts did not have any confirmed measles outbreaks. The spot map of the outbreaks has been depicted in Figure 1.

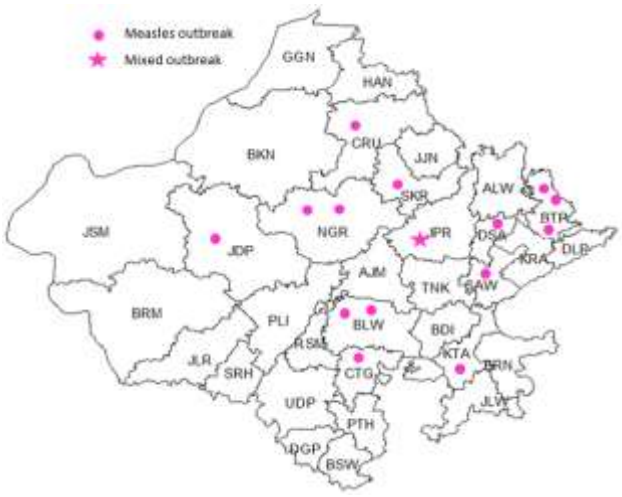

Figure 1: Location of measles outbreak Rajasthan 2014.

District Bharatpur has 3 measles outbreak followed by Bhilwara and Nagaur having 2 outbreaks each (Table 2).

Socio-demographic profile of cases

More than 90 % of measles cases were less than 10 years of age with maximum number (around 50 %) of cases were from the age group 1-4 years. There is significant association between age and disease. Girl child contributed to about 60 % of the total measles cases. Almost 2/3rd (66.9%) cases were in Muslim families. (Table 3).

Vaccination status

In the current study, out of all the 353 measles cases, 108 (30.6%), were vaccinated for measles vaccine. The number of measles cases in unvaccinated group was 138 (39.1%) and in rest 107 (30.3%) of cases the status of vaccination was not known (Table 4, Figure 2). The mean age for vaccinated cases was 50.95 and unvaccinated cases was 53.06. The vaccination status of children below 4 years of age was about 44 % only.

Table 2: District wise distribution of outbreaks and cases.

District	No. of Measles Outbreaks	No. of Measles cases
Bhilwara	2	58
Bharatpur	3	26
Churu	1	17
Chittorhgarh	1	27
Jodhpur	1	20
Jaipur	1	80
Kota	1	14
Nagaur	2	57
Sawai madhopur	1	23
Sikar	1	31
Total	14	353

Table 3: Demographic characteristics of measles cases (n= 353).

		Number of Cases	Percentage (%)
Age (years)	<1	19	5.4
	1 to 4	183	51.8
	5 to 9	129	36.5
	10 to 14	12	3.4
	>=15	10	2.8
	Total	353	100
Sex	Male	142	40.2
	Female	211	59.8
	Total	353	
			P=0.000
Religion	Hindu	117	33.1
	Muslim	236	66.9
	Total	353	100
			P=0.000

Table 4: Age wise vaccination status of the measles cases (n= 353).

Age (Years)	Vaccinated	Unvaccinated	Unknown	Total
<1	2 (10.5)	13 (68.4)	4 (21.1)	19
1 to 4	61 (33.3)	75 (41)	47 (25.7)	183
5 to 9	41 (31.8)	41 (31.8)	47 (36.4)	129
10 to 14	4 (33.3)	5 (41.7)	3 (25)	12
>=15	0	4 (40)	6 (60)	10
Total	108 (30.6)	138 (39.1)	107 (30.3)	353
				P=0.017

Table 5: Religion wise Vaccination status of the measles cases (n= 353)

Religion	Vaccinated	Unvaccinated	Vaccination status Unknown	Total
Hindu	50 (42.7)	37 (31.6)	30 (25.6)	117
Muslim	58 (24.5)	101 (42.8)	77 (32.6)	236
Total	108 (30.6)	138 (39.1)	107 (30.3)	353
				P=0.002

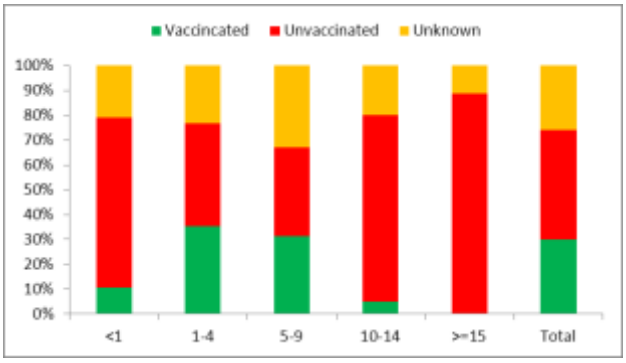

Figure 2: Vaccination status of the measles cases (n= 353)

The vaccination status amongst the Hindu cases was higher (42.7%) as compared to (24.5%) in the muslim cases (Table 5).

DISCUSSION

In the present study, there were 14 measles outbreak and one mixed outbreak out of total 23 outbreaks. A total number of 37 outbreaks were reported in North - East India in 2014-15; out of which 25 (67.57%) outbreaks were observed to be positive for Measles, 10 (27.02%) outbreaks were of Rubella and 1 (2.70%) outbreak was mixed (both Measles and Rubella).[21] In a study from Maharashtra in 2013, of the 98 outbreaks, 61 were confirmed as measles, 12 as rubella and 21 as the mixed outbreaks.[22]

Measles is mainly the disease of the childhood and the current study further strengthens this fact with the observation that more than 90 % of measles cases were less than 10 years of age. Available surveillance data demonstrates that 90% of confirmed measles cases occurring in outbreak settings in states with low measles containing vaccines- first dose (MCV1) coverage (<80%) are among children less than 10 years of age.[9] Other studies also points out towards same age phenomenon where, In India, in 2010, among 8,984 measles patients from laboratory-confirmed outbreaks, 7% were aged <1 year, 41% were aged 1–4 years, 37% were aged 5–9 years.[23] Similar findings were observed from district Bajura of Nepal where 97 % of them were under 15 years of age.[24] A study from Madhya Pradesh also indicates the bimodal age distribution of cases with a peak incidence in 2-3 years and in 5-9 years where majority of the cases (65.9%) were recorded in children under the age of five.[25]

In the present study, the mean age of the cases was 57.44 months with the median 48 months. The age range was from 04 – 540 months. In a study from Kerala the mean age of the cases in the year 2007 was 72.3 months and in 2008 was 78.5 months.[26] In a study from North east India, median age of the cases was 72 months, which was comparable to the previous outbreaks reported in India.[21]

According to a report by Government of India in 2015, State with high percentage of immunization sessions where all vaccines were not available were Uttarakhand (45.5%), Rajasthan (42.9%) and Maharashtra (42.2%).[27] This fact is indirectly reflected in the present study where the vaccination status among the cases was about 31 %. In a study from North- East India, about 23.30% were vaccinated while 76.70% were either not vaccinated or were not documented.[21] In a similar study from a south Indian state, the cases that were immunized but developed the disease were 28.6%.[26] In Uttrakhand, among the measles cases, 89.8% cases had received single dose of measles vaccine.[28]

In a study on Measles and Rubella outbreaks in Maharashtra during 2013, Measles RT-PCR showed presence of measles RNA in 18 samples, further sequencing of PCR products revealed circulation of D4 (n=9) and D8 (n=9) strains. [22] In the present study, the D4 strain was revealed in one district and D8 in three districts of Rajasthan.

The district level household and facility survey (DLHS-3) survey was conducted in 2007–2008 and did show an improvement in measles immunization coverage overall (68%) and in each of the high mortality states (Bihar 54%, Uttar Pradesh 47%, Madhya Pradesh 57%, Rajasthan 67%, Haryana 69%, Gujarat 73%). However, all remained at sub-optimal levels for interrupting measles transmission. Even within states, measles containing vaccines (MCV) coverage was not homogenous. In the same survey, it was observed that in Bharatpur district of Rajasthan, only 20.1 percent children between ages 12-23 months received at least one dose of Vitamin A.[29]

In both DLHS-2 and DLHS-3, the proportion of girls immunized with MCV was lower than for boys in all of the highest burden states. The mortality rate from measles was higher in girls than in boys for each region studied, ranging from 27% higher in the northeast to more than twice as high in the west.[30] A higher proportion of males lines, were affected in the various other studies as

compared with females.[21,25] The reason for the findings may be the difference in the gender ratio in study areas or due to the differential attitude of the parents toward a female child.[25]

CONCLUSION

There was clustering of outbreaks in few of the districts adjacent to each other. Measles vaccination coverage in few pockets was poor in outbreak districts which are reflected in the observations of more measles cases measles in unvaccinated group. The girls were more affected which could be due to gender discrimination prevalent in this part of the country. More cases in Muslim population could be due to social and religious resistance to vaccination. More detailed studies including the knowledge, attitude and practices of the local communities are required for further understanding of measles outbreaks.

Recommendations

There is a need to strengthen routine immunization activities in the outbreak districts. Special attention is required for high risks areas like urban slums, migratory population, minority settlements etc. The self-help groups should be involved for motivating the community for wide spread vaccination coverage. Special attention is required for those communities where there is a discrimination against girl child. Utilizing the experience of polio eradication program, help of local influential social and religious leaders should be obtained to overcome social and religious resistance against vaccination. The second dose of measles (MCV2) coverage needs to be expanded to boost up immunity against measles. The surveillance needs to be strengthened more.

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